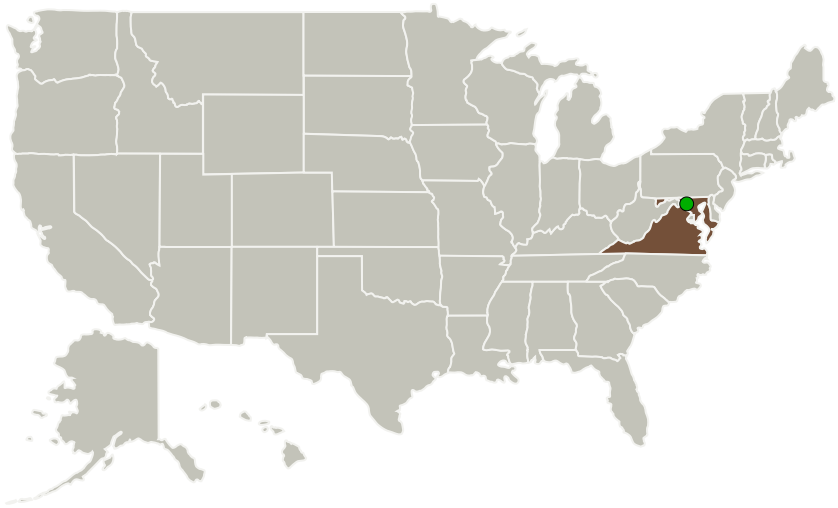
# Enhanced Path Planning, Guidance, and Estimation Algorithms for NASA's GMAT, Phase I

Completed Technology Project (2012 - 2012)

## Project Introduction

Advanced trajectory design and estimation capabilities in complex nonlinear dynamical regimes represent two of the greatest technical challenges of modern space flight. In addressing these challenges, DECISIVE ANALYTICS Corporation seeks to advance the capabilities of NASA's open source General Mission Analysis Tool to integrate the latest advances in trajectory path planning and estimation. This includes the development of an Advanced Path Planning (APP) plugin that leverages concepts from dynamical systems theory, multi-phase targeting, and visualization for trajectory design in regions where multi-body effects are significant, such as near the libration points. Parallel to that is the development of an Advanced Estimation (AE) plugin, which leverages the results of past studies done at DECISIVE analytics for the Missile Defense Agency and the US Air Force. The proposed AE plugin will be designed around a Hybrid Dynamic Bayesian Network framework, pioneered by DECISIVE ANALYTICS, which will enable advanced estimation capabilities including Unscented Kalman Filters and Gaussian Mixture Models. These two techniques, particularly Gaussian Mixture Models, offer enhanced predictive capabilities for the determination of the true probability density when nonlinearities significantly influence the estimation process. Phase 1 will focus on the software development, integration, testing, and validation of initial prototypes for both plugins.

## Primary U.S. Work Locations and Key Partners

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| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Decisive Analytics Corporation | Lead Organization | Industry | Arlington, Virginia |
| Goddard Space Flight Center(GSFC) | Supporting Organization | NASA Center | Greenbelt, Maryland |

| Primary U.S. Work Locations | |
|---|---|
| Maryland | Virginia |

## Project Transitions

**February 2012:** Project Start

**August 2012:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/140271)*

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Decisive Analytics Corporation

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

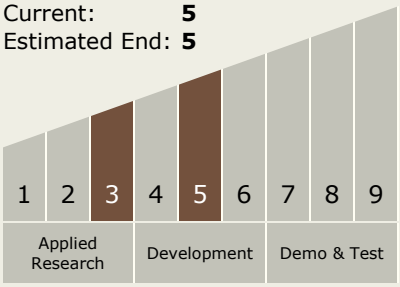
Carlos Torrez

**Principal Investigator:**

Belinda Marchand

## Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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## Technology Areas

**Primary:**

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.1 Guidance and Targeting Algorithms
    - TX17.1.2 Targeting Algorithms

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System